THE DESCRIPTION

And USE of a

Portable Instrument,

Vlugarly known by the Name

OF

GUNTERS QUADRANT.

BY

Which is perform'd, most *Propositions* in *Astronomy*, as the Altitude, Azimuth, Right Ascention, and Declination of the *Sun*, &c. Also his Rising, and Setting and Amplitude, together with the *Hour* of the *Day* or *Night*, and other conclusions Exemplified at large.

To which is added the Use of *Nepiars Bones* in *Multiplication*, *Division*, and *Extraction* of *Roots*: Also the *Nocturnal*. The *Ring Dial*, and *Gunters-Line*, in many necessary and delightful conclusions, fitted to the understanding of the meanest Capacity.

Collected and Digested into this Portable Volumn, for the use of young Practitioners.

By a true Lover of the Mathematicks.

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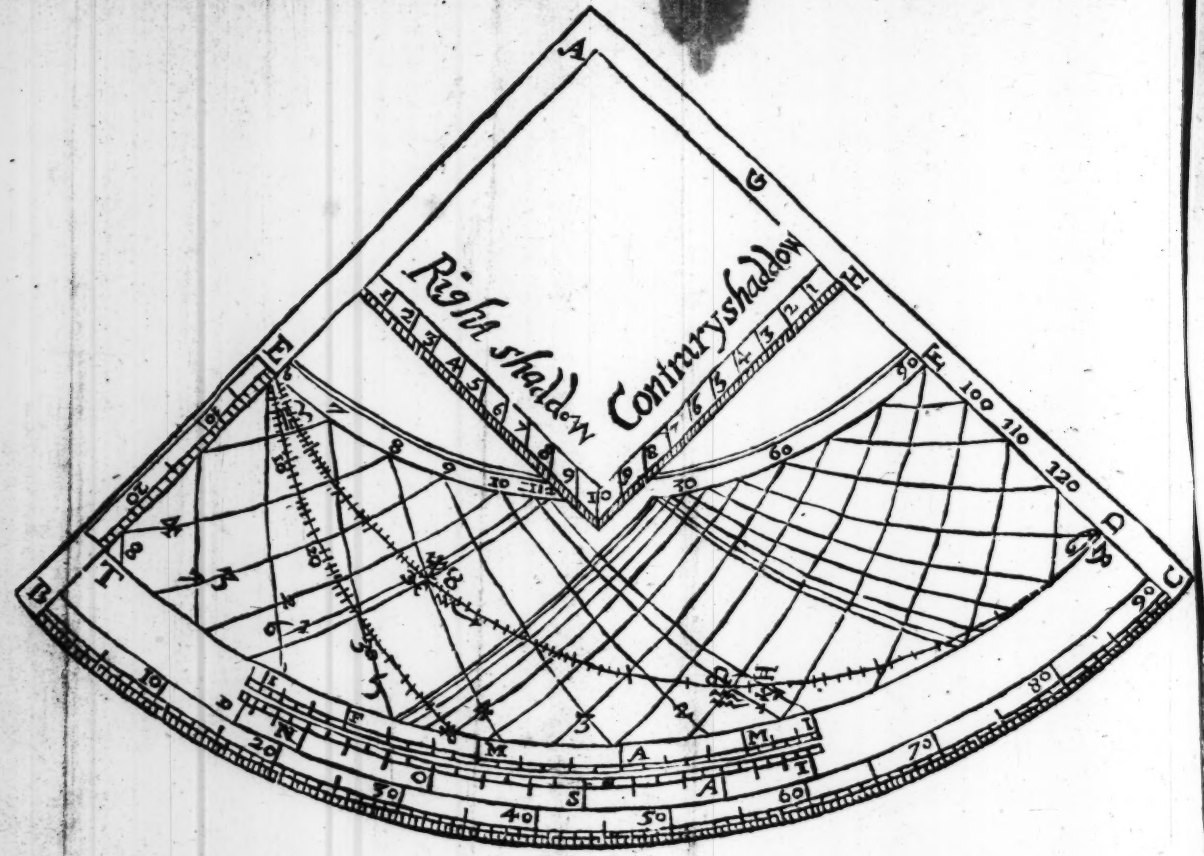
Right shaddow
Contrary shaddow

The USE of a Portable Instrument, Known by the Name of GUNTERS QUADRANT.

SECTION I.

Of the Description thereof.

1. THere needs no large Description of this Instrument for all Persons that are capable of the use thereof know; 'tis but the fourth part of a Circle, and divided in the Limb thereof into 90 degrees by Equal divisions, and Numbered 10. 20. 30. 40. &c. unto 90, each degree being subdivided into 4 parts, above

the Limb; there is Inserted the Twelve months of the year, and Distinguished by Capital Letters, viz. *I.* for *January*, *F.* for *February*, *M.* for *March*, &c. and each month is subdivided into 5 days, more or less according as the largness of the *Quadrant* will bear, and then above the days of the Month you have in the Body of the *Quadrant*, the *Hours* and *Azimuth* Lines, together with part of the *Ecliptick* and *Horizon*, also a *Quadrant*, *&c.* as will be much more obvious and Intelligible to the Reader by Inspection of the Figure thereof hereunto Annexed, then many words.

3. And to make the *Quadrant* compleat there must be added a Couple of Brass eights with small holes therein, fixed to one of the Semidiameters of the *Quadrant*, also a Thred or Silk fastened to the Center, with a Bead and Plummet as is usual, and the making hereof is well known to the work man and

and ſhewed at larg by *Mr. Gunter*. What elſe is neceſſary ſhall be Explained in its uſe.

SECT. II.

Of the Circle of Months.

THis circle of months is Figured with the Letters *J. F. M. A. M.*&c. ſignfying the Months *January*, *February*, *March*, *Aprill*, *May*, &c. each month being Divided unequally according to the Number of the Days that are contain'd therein, as before Intimated

(1) *And now to find out any day of the Month throughout the year*, Firſt ſearch out the Month, and from the beginning thereof account the ſmall Diviſions from one Month to another each of them, for five days, (unleſs your *Quadrant* be Larg and the Month

divided to every day) and by this means you easily find the place (or Division) of the Day of the Month desired, which will be much easier by practice, then can be express'd by words, and here note, that every 10*th.* day is distinguished by a longer Line then the rest, thus, if I lay the Thred (being fixed in the Center) to the 10*th.* day of *January*, 'twill cut in about 21 degrees in the Limb of the *Quadrant:* Now in *June* and *December*, when the *Sun* has his greatest *North* or *South* Declination: The Divisions here run close and so the Day of the *Month* cannot be so exactly found but guesed at, and near enough for most Uses, but in all the other *Months* of the year, there needs not the least Scruple in this particular.

(2.) *Having the day of the Month to find out the Suns Meridian Altitude, or how high he will be at Noon.*

Let the Thred be laid upon the Division called (or Representing) the Day of the Month, and then that very Degree which the Thred cuts in the Limb of the *Quadrant* is the *Suns* Meridian Altitude required; So the Thred laid to the 15*th*. day of *May* will cut 59. *gr*. 30. *M*. in the *Quadrants* Limb which is the *Suns* height that day at Noon, and if it be laid upon the 18*th*. day, the Meridian Altitude will be found 41. *gr*. 39. quarters.

(3.) *The Meridian Altitude being known, to find the day of the month, which is the converse of the former.*

The Thred being laid upon the Meridian Altitude, doth also fall upon

the day of the Month: So that if you have any one of them you have both. So if the Altitude at noon be 59 *gr.* 30 *min.* (as before) and the Thred being set thereunto, it falls upon the 15*th.* of *May* and the 9*th.* of *July* and which of these two is the true day may be distinguished by the Quarter of the year, or another days observation. For if the *Altitude* prove greater, the Thred will fall on the 16*th.* day of *May* and 8*th.* day of *July*, or if it prove lesser the Thred will fall on the 14*th.* day of *May* and the 10*th.* of *July*, and thus the doubt is fully determined, and by this we discover also what days of the year are of equal length, which must needs follow by Consequence if the Meridian Altitudes be equal, and so the 5*th* of *September* and 18*th.* of *March* have the same *Meridian Altitude*, and the same Length which is to be understood in in the rest of the Months, as they stand

ſtand oppoſite in their proper Circles.

(4.) And here 'tis to be obſerved that this *Quadrant* is Accomodated but to one *Latitude*, and therefore (in this caſe) ſerves but for one place, and ſuch which lye parallel thereunto *viz.* eaſt or weſt from thence (as ſuppoſe from the *Metropolitan City* of *London*) thoſe that lye 60 or 70 miles *North* from this Parallel, the *Sun* will be a degree Lower, then appears by the Quadrant at Noon, and the contrary one degree higher for the meridian Altitude to ſuch as live 60 *or* 70 miles *South* from *London*; or ſuch places that lye parallel to it, this is to be underſtood if you be Regulated by the day of the Month upon the Quadrant.

(5.) But if you obſerve the Suns *Altitude* juſt at *Noon* (or a little before, and a little after Noon) by holding the Quadrant in both your hands turning

your left hand towards the *Sun*, so that the Beams thereof may pass through the holes of the sights, then the Plummet hanging at liberty, the degrees cut in the Limb by the Thred is the Altitude desired in any place, and the same may be done by the *Moon* and *Stars* if you look through the sights at the *Moon* or *Stars*, and observe then what degrees are cut by the Thred in the Limb, so upon the 14*th.* day of *April* just at Noon, the *Sun* Beams passing through both the sights, the Thred will fall upon 51 *gr.* 20 *min.* the true meridian Altitude of the *Sun* in the Latitude of *London*, for which meridian most of these *Quadrants* are made.

SECT

SECT. III.

Of the Hour Lines on the Quadrant.

(1) Observe that the *Arch* drawn upon the *Center* of the *Quadrant* to the beginning of the *Suns* Declination doth Represent the Æquator or Æquinoctial circle (and is usually made a *Radius* or *Tangent* of 45 degrees; But that Arch which is drawn by 23½ degrees 30 *min.* of Declination, and is just above the Circle of *Months* and days Represents the *Tropick*, of *Capricorn* and *Cancer* or the *Suns* Greatest Declination both North and South, and those Arch-Lines which are discribed upon the *Quadrant* between the *Æquator* and the *Tropicks*, being undivided and Numbered at the Æquator by 6, 7, 8, 9, 10, 11, 12, and at the *Tropicks* by 1, 2, 3,

2, 3, 4, 5, 6, 7, 8, Those very lines or Arches are the Hour-Circles.

(2.) That which is drawn from 12 in the Æquator to the middle of *June*, Represents the hour of 12 in the *Summer*, and those which are draw with it towards the Right hand are the Hours of the day in *Summer*, and also of the Night in *Winter*. But that Arch which is drawn from 12 in the *Equator* to the middle of *December* Represents the hour of 12 in the *Winter*, and those Arches with it to the left hand the rest of the Hours of the day in *Winter*, and night in *Summer*, and of both these, that which is drawn from 11 to 1, serves for 11 in the *Forenoon* and 1 in the *Afternoon*, That which is drawn from 10 to 2, serves for 10 in the *Forenoon* and 2 in the *Afternoon*, the Reason is that the same day the Sun has the same Altitude 2 hours before noon, as 2 hours after noon

noon, and the same reason is to be understood in all the rest which is plain and easily understood as by the following Propositions will clearly appear.

(3.) *The Day of the month or Meridian Altitude of the* Sun *being given to find the Place of the* Sun *in the* Ecliptick.

Let the Thred be laid to the day of the Month or to the *Suns* height at *Noon* (for the one gives the other) observe then where it crosses the hour of 12, and set the Bead to that Intersection, then move the Thred till the Bead fall on the Ecliptick circle (which is known by the Characters of the 12 signs) and it will fall upon the Suns place & so if it were the 15*th.* of *May*, or Meridian Altitude 59 *gr.* 30 *min.* Lay the Thred as aforesaid, and put the Bead to the Intersection of

of the Hour of 12, and then move the Thred till the Bead fall on the *Ecliptick*, and it will there touch upon the *4th.* degree of *Gemini* and the same of *Sagittary*, also the *26th.* of *Cancer* and the 26 degree of *Capricorn*, and which of these is the place of the Sun, may appear by the *Quarter* of the year, or another days Observation.

(4.) To Rectifie the Bead for the hour of the day, &c.

Knowing the day of the Month, place the Thred thereon, and then slip the Bead to the Meridian or hour of 12, for the season of the year, then you are fitted to find the Hour by the *Sun*, but for the *Stars* only lay the bead upon the Star proposed. And thus the Bead being Rectified if you do but observe the Altitude of the *Sun*, the Bead will fall on the Hour Line

Line desired, or sought, if you bring the Thred the Altitude: So on the 10*th* of *April* having Rectified the Bead for the time, you may find the Altitude 36 *gr.* at the same time the Bead falls upon the Hour line of 3 and 9, and then I may conclude 'tis 9 in the Forenoon, or 3 in the afternoon, and so upon the 9*th.* of *April* the Bead being Rectified and the Altitude observed 3 *gr.* the Bead will fall between 8 and 9 in the Æquator and between 3 and 4 in the *Tropicks*, so that 'tis half an hour past 8 in the Morning or half an hour past 3 in the afternoon, and here observe if the *Sun* ascends, it is before Noon, but if the *Sun* descends or falls in Altitude, 'tis afternoon as *Reason* it self will direct; so again upon the aforesaid 10*th.* of *April*, if the Suns Altitude be 40 degrees you will find the Bead at the same time fall half way between the hour Lines 9 and 3 and 10 and 2, where-

wherefore it must either be half anhour past 9 in the Morning, or half an hour past 2 afternoon, which is most easily Distinguish'd. And after the same Method if upon the first of *November* I observe as aforesaid, and find the Bead to fall half way between 8, and 9, and 3 and 4 in the winter Hour circles: Hence I conclude 'tis half an Hour past 8 in the forenoon, or half an hour past 3 in the afternoon *et sic de ceteris.*

(5.) *The place of the Sun in the Ecliptick being known to find the day of the Month.*

Lay the Thred and Bead on theplace of theSun in the *Ecliptick* &then move the Thred and Bead to the hour of 12, and so if the place of the Sun be 4 degrees of *Gemini*, the Bead being laid to this degree, and then moved to the hour of 12 in *Summer*, the Thred will fall on the 15*th.* day of *May* or the 9*th.*

9*th*. of *July*: or if it be moved to the hour of 12 in *winter*, the Thred will fall on the 6*th*. of *January* and the 16 of *November* and which of these is the day of the Month required, the Quarter of the year will determine.

By this and the third Proposition there is two ways shewed to Rectifie the Bead by the place of the *Sun*, and by the day of the Month, and the best way is accounted by the place of the *Sun*; for in the other some small difference may arise by the Leap-year. There is also a Third way by a Table of the *Suns* declination for each day of the year (which Seamen are seldom without) and if so, the Bead may be set thereunto in the Line of declination.

(6.) *To know how high the Sun will be at any hour of the day given throughout the year.*

The Bead being Rectified for the Time, by any of the ways aforelaid, Bring it to the hour given from the hour of 12 towards the Line of declination, and the degrees cut by the Thred in the Quadrant or Limb there, will shew the Altitude of the *Sun* at that time, so upon the 26*th*. of *March* at 8 in the Morning, and 4 in the afternoon, the Sun will be found to be 24 *grad.* 30. *min.* high. Again, on the 10*th* of *April* the *Sun* being in the beinning of *Taurus*, the Bead being Rectified you shall find the Altitude at Noon at *London* 50 *gr.* 0 *min.* But at 11 in the Morning 48 *gr.* 12 *min.* at 10 of the Clock but 43 *gr.* 12. *min.* at 9 only 36 *gr.* at 8 of the clock 27 *gr.* 30 *min.* at 7, but 18 *gr.* 18 *min.* at 6 in the

the Morning, but 9 *gr.* and at 5 a clock it touches the Line of Declination, and has no Altitude at all, whence we may conclude the *Sun* did Rise much about that Hour. And then if you move the Thred again from the Line of Declination towards the Hour of 12, you shall find the *Sun* 8 degrees, 33 *min.* below the Horizon at 4 in the Morning, and near 16 *gr.* at 3 and 21 *gr.* 51 *min.* at 2, and 25 *gra.* 40 *min.* at 1, and 27 degree at Midnight. For the Bead being Rectified as aforesaid and brought to the Hour of the Night (which as before was Intimated are the winter Hours in *Summer* and the Summer hours in winter) then the Thred in the Limb cuts the degree of the Suns Depression for any hour of the night, and thus 'twil be found that at a 11 of the Clock at night the 30*th* of *March* the Sun will be found at least 28 degrees and 30 *min.* below the Horizon.

(7.) *The Hour of the Night given to find the* Suns *Depression.*

And here let it be Observed that the Sun is always as much below the Horizon at any hour of the Night, as his oppoſite point is above the Horizon at the like hour of the day, and therefore (to make this more plain) The Bead being ſet, if the Queſtion be put for any Hour of the Night in the *Summer*, then move it to the like Hour of the day in the *Winter* Hours: But if of any hour of the Night in *Winter*, then move the Bead to the like Hour of the day in *Summer*, and ſo the Degrees cut by the Thred in the Limb of the Quadrant ſhall ſhew how much the *Sun* is below the Horizon at that Time, and ſo ſuppoſe it the 10*th*. of *April* at 4 of the Clock in the Morning, the Bead being ſet to his place according to the Time in the Summer hours, and brought

brought to 4 of the clock in the afternoon in the Winter hours, you will find the Thred to cut 8 *deg.* and about 30 *min* in the Limb of the Quadrant which is the true depreſſion of the *Sun* at that time.

(8.) *The Depreſſion of the Sun ſuppoſed to give the Hour of the Night with us, or the hour of the day to our Antipodes.*

In Regard the *Sun* is as much above the *Horizon* at all hours of the day, as his Oppoſite point is below the *Horizon* at the like hour of the Night: Therefore firſt ſet the Bead according to the Time, and then bring the Thred to the degree of the Suns Depreſſion below the *Horizon*, ſo ſhall the Bead fall on the contrary Hour Lines, and there ſhew the Hour of the Night in reſpect of us which is the like hour of the day to our *Antipodes*;

So

So the 10*th.* of *April,* the Sun being then in the begining of *Taurus,* and by Supposition, 8 *gr.* 30 *min.* below the Horizon in the East, it is required to know, what time of the Night it is, first set the Bead according to the day in the Summer hours, then bring the Thred to 8 *gr.* 30 *min.* in the Limb of the *Quadrant* so shall the Bead fall among the Winter hours on the Line of 4 of the Clock in the afternoon, wherefore to our *Antipodes* 'tis 4 of the clock in the afternoon and to us 4 in the Morning.

(9.) *Having the time of the year, or the place of the Sun being known, how by this Quadrant to find the Beginning of Day break and end of Twilight.*

There is very little Difference between this proposition and the former; for the day is said to Break when the

the Sun comes to be but 18 *deg.* below the *Horizon* in the East, and Twilight to end when the *Sun* is 18 *deg.* below the *Horizon* in the *West*, wherefore let the Bead be set for the time, and then bring the Thred to 18 *gr.* in the *Quadrant*, so shall the Bead, falling upon the contrary hour Lines, there shew the hour of *Twilight* as before in the operation of the last proposition, and so 'twill be found a little more then a Quarter after 3 in the Morning, for day break upon the 10*th.* of *April* after the same manner upon the 30*th.* of *March* day break will be found to be at 3 of the clock in the Morning, and if so we may easily Judg when 'twill be dark at Night, which is said to be as much after 6 as this before 6, and then we may conclude 'twill be dark at 9 of the Clock at Night, it being then past Twi-light.

SECT

SECT. IV.

Of the Azimuth Lines.

(1.) Observe that those Arching-Lines which are drawn between the Æquator and the Tropicks on that side of the Quadrant towards the right hand or neareſt to the *ſights*, and are Numbered with 10. 20. 30. 40. *&c.* in the Æquinoctial, then downwards from the Æquator to the Tropick with 110. 120. 130. *&c.* The uttermoſt towards the left hand Repreſenteth the *Meridian*, that which is Numbered with 10 the tenth *Azimuth* from the Meridian, and that which is Numbered with 20 the 20*th.* and ſo of the reſt. Thoſe Lines which are drawn from the Æquator to the left hand do ſhew the *Azimuth* in the *Summer*, and thoſe other to the Right hand,

hand do ſhew the ſame in the Winter, the uſes of them follow.

(2) *The Azimuth the* Sun *is upon, being known, to find the* Altitude *of the* Sun *above the Horizon.*

Firſt let the Bead be ſet for the Time, as before is ſhewed, then move the Thred until the Bead fall on the *Azimuth*: So the degrees which the Thred cutteth in the Quadrant ſhall ſhew the Altitude of the Sun at that time, where you are to obſerve that, in regard the *Azimuths* are drawn on the Right ſide of the *Quadrant*, you are alſo to begin to Number the Degrees of the *Suns Altitude*, from the Right hand towards the left, contrary to the Directions of ſome former propoſitions; Examples will clear this point: Suppoſe the Time given were the ſecond of *Auguſt*, when the *Sun* hath but 15

deg. of North Declination, Set the Bead for the time and the Suns Meridian Altitude or height at Noon will be found 53 *gr.* 30 *min.* but when he is 10 *gr.* from the South 53 *gr.* 10 *min.* when 20 *gr.* then about 52 *gr.* 8 *min.* when 30. then 50 *gr.* 20 *min.* when 40, then 47 *gr.* 28 *min.* when 50, then 44 *gr.* 12 *min.* when 60. then 39 *gr.* 35 *min.* when 70 then 33 *gr.* 50 *min.* when 80, then 27 *gr.* when the Sun is in the east or west 90 *gr.* from the Meridian then is the Altitude near 19. 20 *min.* when 110. then 3 *gr.* 20 *min.* and before he cometh to the Azimuth 120 *gr.* he has no Altitude for the Sun having 15 *gr.* of North Declination will Rise and Set at 114 *gr.* 34 *min.* *Azimuth* from the Meridian.

(3) *The Altitude of the Sun being given to find, on what Azimuth or point of the Compass he bears from us.*

Set the *Bead* in his proper place for the day proposed (as before Directed) and then Observe the Suns Altitude, then lay the Thred to the Complement of that Altitude, (which is but Accounting so many degrees from 90 *deg.*) on the *Quadrant*, so shall the *Bead* fall upon the true *Azimuth* required. *Example*; Suppose upon the second of *August* (having Rectified the Bead) you observe and find the Suns Altitude to be 19 *gr.* 20 *min.* Then Remove the Thred to the Complement thereof *viz.* 70 degrees. 40 *min.* or which is all one upon 19 *gr.* 20 *min.* accounted from 90 degrees from the right hand to the left, and the Bead will fall upon 90 degrees from the Meridian, and there-

fore the point the *Sun* is upon bears from us, either Full *East* or Full *West*, & which of these it is may immediately be discovered by a Second observation; for if the *Sun* increase in Altitude, 'tis Forenoon, and the *Azimuth* East. If the *Sun* Decrease in Altitude 'tis Afternoon, and then the Azimuth is West, which is as easily discovered, by the Hour of the day: And so again, If I find the Suns Altitude to be 25 *degr.* if I lay Thred to 25 *degr.* Accounted backward from 90 *deg.* the Bead will upon every near 80 *deg.* from the South, and that is the point of the compass the Sun is upon Eastward, if in the Morning, and Westward if in the Afternoon By these propositions you may know the Altitude of the *Sun* every hour of the day, though he appear not, and what part of the Heavens he is in likewise, and then knowing what *Azimuth* the *Sun* beareth from us you may find not only

only a Meridian Line, but the Coasting of a Country, the Scituation of a Building and the variation of the compass *&c.* As for *Example*, Suppose some day in the afternoon I should find by the aforesaid Direction, that the *Sun* bears from me 60 degrees from the South towards the West, then there being 90 *deg.* in each Quarter of the compass; the West will appear to be 30 *deg.* to the Right hand, the East is just opposite to the West, and the Meridian Line or North and South lye in the midst between them.

4 *To find the* 4 *Cardinal points upon an Horizontal Plain.*

First find the *Azimuth* of the *Sun*, and instantly lay your *Quadrant* upon the Plain, so that the Face thereof may lye uppermost, then hold in your hand some small string with a *Plummet* hanging thereunto, and Move

the *Quadrant* till the Sun casteth the shaddow of the string through the degree of the Limb which was found for the *Azimuth*, and through the Center of the Quadrant, then holding the Quadrant still draw right Lines by each side thereof, and protract them, so that they may Cross each other, and these Lines shall point out *East*, *West*, *North*, and *South*.

(5) *If two several Sun shaddows be Observed the one in the forenoon, and the other in the Afternoon of the same day, exactly to touch with their ends, the Circumference of the same circle discribed in a Plain, Parallel to the Plain of the Horizon; The Line from the Center Equally dividing the the Arch of that Circle betwixt the two shaddows will be the true Meridian in that place.*

This is a Useful Theorem and may be

be better underſtood by Example *viz.* Take a piece of Board or Mettle and let it be ſo evenly placed, that it may lye parallel with the Plain of the Horizon: In this Plain Deſcribe divers Circles from the ſame Centre, and in that Centre, raiſe a Gnomen at Right Angles. This Platform being thus Ordered let the ſhaddow of the Gnomen or wire be obſerved ſometimes beforenoon, till ſuch time it do exactly touch the circumference of one of theſe Circles. Again in the afternoon let the ſhaddow be Obſerved till the end of this Perpendicular touch the Circumference of the ſame Circle, which will exactly happen ſo many hours afternoon, as the other beforenoon, then you are diligently to Obſerve theſe two points in the Arch of the ſaid circle and divide that Arch into two equal parts by a Line from the centre, this very Line is a true Meridian Line, upon

which when the shaddow falls, you may be sure 'tis just 12 of the clock, or just high Noon.

6 *To find the Declination of a Wall for the making of a Declining Dyall:*

Apply one Edg of the Quadrant to the Wall, and at the Limb hold up a Thred and Plummet, so that the shaddow thereof may pass through the Centre then mark what degree of the Limb the shaddow of the String so held shall touch, then presently find the Degree in the Limb of the *Suns Azimuth* at that time; then if you have done right, the degrees between the degree of the *Azimuth* of the *Sun* and the degree of the shaddow of the string, so mark'd, shall be the degree of the Declination of the wall from the true Meridian, which whether it be *Eastward* or *Westward* may be known

known by comparing it with the *Sun*. And not, this propoſition may be the better performed the farther the *Sun* is from the Meridian.

7 *To find how much a plain or* Wall *declin's from the Zonith.*

Apply the Edg of the *Quadrant* to the *Plain* or *Wall*, ſo that the Center may be downwards and the Limb upwards, then hold a String and Plummet, ſo that the Thred or String may touch the Centre and the Limb, and Number the Degrees between the *Plain* and the ſtring, and they ſhew the Quantity in Degrees of the Plains Reclination.

8 *To find the Elevation of the Pole in any Place.*

Firſt take the Meridian Altitude of the *Sun* by Obſervation, (or other-

wise) and also the *Suns* Declination (as shall be shew'd) which if it be *Northwards* then *Substract*, if *Southwards*, add to the *Suns* Meridian Altitude, and you have the complement of the Poles Elevation, or the *Æquinoctial* height, which Subducted out of 90 degres, leaves the Latitude of the Place desired, which is so Plain it needs no Example.

SECT. V.

Of the Ecliptick Circle or Arch.

(1) THe *Ecliptic* is easily distinguished from the other Circles, and is Represented by the Arch to which is annexed the Characters of the 12 signes, and is drawn from the Hour-Line of 6 in the *Equator*, to the other side of the *Quadrant* ending in the Tropicks of *Cancer* and *Capricorn*; each

each ſign being divided unequally into 30 deg. which is to be reckoned both ways from the *Characters* of the 12 Signs, *Aries*, *Taurus*, *Gemini*, *Cancer*, *Leo*, *Virgo*, *Libra*, *Scorpio*, *Sagitary*, *Capricorn*, *Aquary*, *Piſces*, which *Signes* do alſo anſwer to the 12 *Months*, and the *Thred* being layd upon the day of the *Month*, and the *Bead* rectified or brought to the proper Meridian, or 12 as before has been Exemplified, according to the ſeaſon of the year, *viz.* to the *Summer* 12 in *Summer*, and the *Winter* 12 in *Winter*, &c. Then bring the *Bead* to the *Ecliptic* (ſo rectified) and it will fall upon the *Suns* place therein for that day, regard being had to the time of the year ſo upon the 18 of *March*, the *Sun* placed by the falling of the *Bead* will be about 8 degrees of *Aries*, and upon the 17 of *October* in 3 degrees of *Scorpio*.

(2) In finding the place of the *Sun* in the *Ecliptic*, 'tis neceſſary to know which

which way the *Sun* declines from the Æquator, for if he declines *North* the character belonging to his place is above the *Ecliptick*, if *South* beneath it. Now for as much as the Bead will fall between two *Characters*, you may know which it is by a Second days observation, as for Example, let the 20*th*. of *August* be proposed, the *Thred* being plac'd upon the day, bring the *Bead* to the *Summer Meridian*, which will shew that the *Sun* is then in its *Northern Declination* (because the Beads very plainly shews the same) and the *Thred* being moved falls either upon the 7*th*. degree of *Virgo*, or the 30 degree of *Aries*, which the time of the year will plainly distinguish; for *Aries*, *Taurus*, *Gemini*, *Cancer*, *Leo*, *Virgo*, are the Northern or *Summer Signes*, and *Libra*, *Scorpio*, *Sagittary*, *Capricorn*, *Aquary*, and *Pisces*, are the *Southern* or *Winter signes*, and this proposition will

will be found exceeding eaſie by a little practiſe.

3. If the *Thred* be laid upon the degree of the *Suns* place in the *Ecliptick*. Exactly it will cut in the *Limb* of the *Quadrant* the *Right Aſcenſion* of the *Sun*; So the *Suns* place being 4 degrees of *Gemini*, the Thred laid upon this degree will cut 62 degrees in in the *Limb* for the *Suns Right Aſcenſion* required; but if the *Sun* has paſſed about 90 degrees from *Aries* or more then 3 *Signes*, then there muſt be more then 90 degrees allowed to the *Right Aſcenſion*: Thus if degrees of the *Sun* between *Aries* and *Cancer*, then his *Right Aſcenſion* is the very degrees cut by the *Thred* in the *Limb*; but if the *Suns* place be between *Cancer* and *Libra*, then to the firſt Quadrant you muſt add thoſe degrees cut by the Thred in the *Limb* counting backwards from the *Sights* ſide, if between *Aries*, and *Capricorn* then to

180

180 degrees, add what the Thred cuts, if between *Capricorn* and *Aries*, then to 270 degrees add the degrees cut by the Thred in the Limb, counting backwards again, and you have the *Suns* true *Right Ascension* desired: So if the *Sun* be in 16 degrees of *Cancer* though the Thred falls upon 62 as before, yet the complement thereunto must be added *viz.* 28 degrees, and so the R.A. will be 118 *gr.* So upon the 18*th.* of *March* the R.A. is but 12 deg. but upon the 5*th* of *August* 126 deg. upon the 10*th.* of *October* 208 deg. and upon the 9*th.* of *March* 360 deg. and thus the business of *Right Ascension* is made as plain as possible may be to the meanest capacity *Usus promptus facit.*

And thus having the Right Ascension given, you may by the converse work find the *Suns* place; for lay but the Thred to the *Suns* true *Right Ascension* in the *Limb*, and it will cross the *Suns* place, in the *Ecliptic* desired.

SECT.

SECT. VI.

Of the Line of the Suns Declination.

THE Line of Declination is drawn from the Centre to the beginning of the Quadrant, and divided from the beginning of *Aries* downward to 23 degrees, 30 min.

Its use is thus, rectifie the Bead as before shewed, and bring it to the Line of *Declination* and you have the *Suns Declination* for that day. So if the Suns place given be the 4*th.* Degree of *Gemini* the Bead first set to this place and then moved to the Line of *Declination*, 'twill there shew it to be 21 degrees Declination Northerly from the *Æquinoctial*, and so if you have only the day of the Month given, you may presently find both the *Suns* place and declination also for that day,

day. Thus upon the 17*th*. of *October* the Sun has 12 degrees of *Declination South*. And Note, that if the *Bead* fall upon the *Winter* 12, the Declination is South: But if upon the *Summer* 12 'tis North, and having the Declination only given, you may thereby find the Suns place and day of the Month.

SECT. VII.

Of the Horizon.

1 THE *Horizon* is represented upon the Quardrant by the *Arch* drawn from the beginning of *Declination* towards the end of *February* divided unequally, and Numbered by 10. 20. 30. 40. *&c.*

2. Having the place of the *Sun* or day of the Month, to find the Amplitude of the Suns Rising and Setting.

Let the Bead Rectified to the time given,

given be brought to the *Horizon*, and there it ſhall ſhew the *Amplitude* required, ſo if the day of the Month given be the 15*th.* day of *May*, and the Sun in the 4*th.* degr. of *Gemini*, the Bead Rectified, and brought to the *Horizon* ſhall there fall upon 35 gr. 8 m. and this is the *Amplitude* of the Suns Riſing from the *Eaſt*, and 'its ſetting from the *Weſt*, which *Amplitude* is always *North*, if the *Sun* be in Nothern ſignes, but when he is in Southern ſignes then 'tis always Southward, that is from the 10 of *March* to the 11 or 12 of *September North*, but all the other half year the Amplitude of the Sun is *Southerly*, and ſo upon the 9*th.* of *April*, the Amplitude will be found Juſt 18 degrees *Northerly*, underſtand the ſame method in other operations.

3. The day of the Month, or the *Suns* place given to find the *Suns Aſſential difference.*

Let the Bead Rectified for the time be

he brought to the *Horizon*, so shall the Degrees cut by the Thred in the *Quadrant* shew the Suns Ascensional difference; so upon the 10*th.* of *May* the *Sun* being in the last degree of *Taurus*, or beginning of *Gemini*, let the Bead be rectified and brought to the *Horizon*, and then the Thred in the Limb of the Quardrant shall shew the Ascensional difference to be 27 deg. 30 min. and so upon the 15*th.* of *May* the Sun being about 4 or 5 degrees of *Gemini*, the Ascensional Difference will be found near 29 deg. or rather 28 d. 50 min. so upon the 9*th.* of *April* the *Ascensional Differences* will be found 15 degrees. Now having this, you may thereby find the time of the *Rising* and *Setting* of the *Sun*, (which by some of the former propositions may be guessed at but more accurately thus. If the *Ascensional* Difference be converted into time by allowing one hour for every 15 degrees and 4 min. of an hour for

for each degree, and this will shew how long the Sun riseth before Six in the *Summer* (that is from the 10*th.* of *March* to the 11*th.* or 12*th.* of *September* and after six of the Clock in *Winter*) so if the day proposed be the 15*th.* of *May*, and the place of the *Sun* and *Ascensional Difference* as before *viz.* 28 gr. 50 min. this converted into Time makes one hour and about 55 min. and so long did the *Sun* Rise before six *viz.* at 4 h. and 5 min. in the morning, and consequently sets so much after six, and in the *Winter* so much as the Sun rises after Six; so much it sets before six, hence the Length of the day and night is most easily obtained, for having the *Semidiurnal Ark* or time from Sun-rising to Noon, 'tis but doubling those Hours and Minutes, and you have the length of the day, so 7 hours 25 Min. doubled is 15 hours, 54 min. for the length of the day, *May* the 15*th.* which substracted

ſtracted out of 24 hours, remains 8 hours 6 min. for the length of the Night.

SECT. VIII.

Of the five Stars, &c.

THe *Stars* that where thought convenient (by the Author) to put upon the Quadrant are firſt *Ala Pegaſi* a Star in the extremity of the wing of *Pegaſus*, in regard it wants but 6 minutes of time of the beginning of *Aries*, and becauſe 'tis not always to be ſeen, four more were elected for each Quarter of the Ecliptic, as *Oculus Tauri* or the *Bulls eye*, whoſe Right Aſcenſion in time is 4 h. 15 m. then of *Cor Leonis*, the *Lyons Heart*, whoſe Right

Right Aſcenſion 9 h. 48 m. the next of *Arcturus* whoſe R. A. 13 h. 58 m. and the laſt of *Aquila* or the Vultures Heart whoſe R.A. is 19 h. 33 min. theſe five Stars have all of them Northern Declination, and of all others ſome of theſe will be ſeen (if the Air be clear) every night in the year, their uſe follows, *viz.*

1. The Altitude of either of theſe five Stars being known, to find the Hour of the Night, firſt, put the Bead to the Star which you intend to obſerve, then take his Altitude, and by that find how many hours he is diſtant from midnight, either before or after. Then from the Right Aſcenſion of the Star Subtract the R. A. of the Sun converted into time, and Reſerve the Difference; for this Difference being added to the obſerv'd hour of the Star from the *Meridian* or Midnight, ſhall ſhew how many hours the Sun is gone from Noon which is the hour of the Night.

2. As

2. As for example *May* 15. suppose the *Sun* be in 4 deg. of *Gemini*, and I set the Bead to *Arcturus*, and observing his Altitude, should find him to be in the *West* about 52 deg. high, and the Bead to fall on the hour-line of 2 Afternoon, the hour would be 11 hours, 50 min. past Noon, or but 10 min. short of midnight. For 62 gr. the R. Asc. of Sun converted into time makes 4 h. 8 min. which if we take out of 13 h. 58 min. the R. Asc. *Arcturus*, the Difference will be 9 h. 50 min. and this being added to 2 hours, the Observed distance of *Arcturus* from the meridian shews the Hour of the night to be 11 h. 50 m. as aforesaid.

3. Again to make the business more plain, suppose the 9*th* of *July* and the *Sun* be then in 26 gr. of *Cancer*, I should set the Bead upon *Oculus Tauri*, and Observing his Altitude should find him to be in the *East*, about 12 gr. high, and

and the Bead to fall on the Hour Line of 6 before Noon, which is 18 h. paſt the Meridian, the Hour of the night would be found ſomewhat more then 15 min. paſt 2 in the Morning, which may be proved thus, *viz.* The R. Aſc. of the Sun is 118 gr. which converted into time (by allowing 15. degr. for an hour, and 4 min. for a degr.) it makes 7 h. 52 min. this ſubſtracted out of 4 h. 15 the R. A. of *Oculus Tauri* (adding the Circle, or 360 deg. that Subtraction may be made) the difference will be 20 gr. 23 min. and this being added to 18 h. (which was the obſerv'd Diſtance of the *Star* from the meridian) ſhews that the Sun (abating 24 hours or the whole cirle) is 14 hor. 23 min. paſt the meridian, and therefore 23 min. paſt 2 in the Morning.

4. Now if you have a *Nocturnal* upon the Backſide of the *Quadrant*, you need not uſe this Æquation of *Right Aſcenſion*,

Ascension; for knowing the time of the year, when the Star will be South at midnight, you may bring that time to the hour observed, then will the day of the Month wherein you made your Observation, point at the hour of the night required.

5. As in the first example, whereon the 15*th* of *May*, the Bead set to *Arcturus* fell upon the hour Line of 2 afternoon, because this Star will be in the *South* the 14*th* of *October* compleat at Midnight, you may place the 14*th*. of *October* at the hour of 2, so the 15*th*. of *May* will point to 11 h. 50 m. as before, the hour of the night desired.

6. And in the second example of the 9*th*. of *July*, where the Bead set to the *Bulls Eye* fell on the hour Line of 6 before noon, because the *Bulls Eye* will be in the *South* the 16 of *May* compleat at Midnight, you may turn the 16*th*. of *May* to the hour of 6, and thereby you shall

ſhall find the 9*th.* of *July* to point unto 2 h. 23 min. as before.

SECT. IX.

Of the Quadrant.

1. THE Quadrant hath 2 ſides only divided, and the other 2 ſides next unto the Centre may be ſuppoſed to be divided, each of them into 100 equal parts, that which is next to the Horizontal Line contains the parts of right ſhaddow, the other next to the ſights, the parts of contrary ſhaddow, and its uſe, follows.

2. *Any point being given to find whether it be Level with the eye or not.*

If you lift up the Centre of the *Quadrant*, ſo as the Thred with the Plummet may play eaſily by the ſide of it, then Look through the ſights to the

place given, and if the thred fall upon the Line A. B. drawn by the side of the *Quadrant* (called the Horizontal Line) then is the place given Level with the eye; but if it fall within the said Line on any of the Divisions then it is higher, if without it must needs be lower then the true Level of the eye.

3. *To find any hight above the Level of the eye, or a distance at one Observation.*

Look through the sights to the Place, going nearer or farther from it, till the thred fall on 100 parts in the *Quadrant* or 45 degr. in the *Quadrant*, so shall the hight of the place above the level of the eye, be equal to the distance 'twixt the place and the eye. But if the Thred fall on 50 parts of Right shaddow, the hight is but half the distance, if it fall on 25 it is a quarter of the distance if on 75 'tis three quarters of the distance, for as oft as the Thred falls upon the

the Parts of Right Shaddow, it holds this proportion, *viz.*

As 100 *to the parts upon which the Thred falls.*
So is the distance to the hight required.

And so on the contrary.

As the parts cut by the Thred are to 100
So the Hight to the Distance.

4. But when the Thred shall fall upon the parts of Contrary shaddow, if it fall on 50 parts the Hight is double unto the Distance, if on 25 'tis 4 times as much as the Distance. For as often as the Thred falleth on the parts of Contrary shaddow the proportion is.

As the parts cut by Thred are to 100 *so is the Distance unto the Hight.*

And the Contrary,

As 100 *are unto the parts cut by the Thred, so is the Hight unto the Distance.*

And what is here said of Hight and Distance, the same may be understood of hight, and shaddow.

(5) *To find a Hight or distance at two Observations.*

Suppose the Place which is to be Measured could not otherwise be approched, & yet it were required to find the Hight and the Distance; first I make choice of a Station where the Thred may fall on 100 parts in the *Quadrant* and 45 degr. in the *Quadrant*; then shall the Distance from the Object be equal to its Altitude: then if I go farther in a direct Line with the former Distance, and make choice of a second Station, where the Thred may fall on 50 parts of

of Right ſhaddow; then ſhall the Diſtance from the object to my Station be double to the Hight of the object: wherefore if I meaſure the difference between the two Stations, it will be equal both to the firſt Diſtance and the Altitude of the object. But if I cannot make choice of ſuch Stations then I take ſuch as I may, as ſuppoſe one where the Thred falls upon 50 parts of Right ſhaddow, and the ſecond upon 40 and ſuppoſe the Altitude of the object 100, &c. The proportion holds.

As 50 *parts are unto* 100 *the ſide of the Quadrant.*

So 100 *the ſuppoſed height unto* 200 *the Diſtance.*

And as 40 *parts at the ſecond Station unto* 100.

So 100 *the ſuppoſed hight unto* 250 *the Diſtance deſired.*

Wherfore the Difference between the two laſt Stations ſhould ſeem to be

50, and then if in the Measuring of it I find it to be either more or less, the proportion holds as from the supposed difference to the measured difference, so from hight to hight, & from distance to distance: as if the differance between the two last Stations being Measured, were found to be 30, then say, by the Rule of proportion, or the Golden Rule.

As 50 the supposed difference unto 30 the true
So 100 the supposed hight unto 60 the true Altitude.
And as 200 the supposed distance unto 120 the true, so 150 at the second Station unto 250 the Distance required.

(6) If standing upon a known Altitude, and you would thereby know the Distance, work as you did before only that which was then the parts of Right shaddow must now be the parts of contrary shaddow, and that which was then the parts of contrary shaddw must

must now be the parts of Right shaddow.

SECT. 10.

The Discription and Use of the Nocturnal which is usualy put upon the Backside of Gunters Quadrant.

1. IT'S an Instrument fitted chiefly to know the hour of the night by the Stars: It consists of two parts, the Fixed and the Movable, the Fixed part being the outermost Circle is divided in 24 parts representing the Hours of the Night, of which so many as are necessary are inserted, which are from 4 in the Afternoon till 8 in the Morning: each hour is divided into halfs, quarters, and half quarters, and farther according as the Instrument will bear, this part must be fixed on the

Back of some other Instrument, or it may be used by it self.

2. The other part is *Moveable* on its Centre, the outward Circle next the edg is divided into 365 parts, representing the days of the year, and these are divided into Months which are distinguished by Divisions and Figures to know every day as is usual, & the Name to each Month. Within this Movable place there is inserted five Constellations of those Stars that are next the North Pole, and in some a Star of the first Magnitude called *Hircus*, all which (without incumbering the Nocturnal with more) are sufficient for this use. There is likewise a Thred to be added, lying on the Diameter from 12 to 12 which serves for a Meridian, to which those that please may have added a Scale of Declinations & a Circle divided into 360 degrees for finding the Right Ascension, and Declination of these Stars, but

but that work may be done with eaſe many other ways and is uſually omitted in the Inſtrument.

2. The uſe of this Inſtrument is thus, Firſt, Learn to know the Stars which are uſually placed upon this Inſtrument, which is very eaſy from the bare Inſpection of the Nocturnal it ſelf, & they are moſt eaſily known in the Heavens; If you turn your ſelf to the North, and there obſerve the ſeven great Bright Stars, in the greater Bear, called by moſt people *Charles's wayne*, thoſe four in a ſquare form are in the Body of the Bear, the three other are in the Bears tayle: having found theſe take Notice that the two Stars in the Square farthermoſt from the Taile of the Bear, do in a ſtreight Line point to another Star almoſt as Bigg as they are (which is in the tip of the little Bears tayle) and called the polar Star, or North Star, 'tis very near tho. not exactly in the Pole

Pole. These being known the rest will be easily found out, by bare inspection of the Instrument.

3. The Stars being known, Now for the more certain finding of the hour of the night, it will be necessary to find a Meridian, which is a Line or Arch conceived to be drawn through or near the North Star, and so right over your head, & round about by the South just under your feet until it meet in the North Star again: or to spake more properly it is a Circle that passes through the *North* and *South* Poles & the *Zenith* & *Nadir* of the place, & divideth the Firmament in to the East and West Hemisphers, and to find this Meridan; I have already shewen in the use of the Quadrant. One good way may be in some Garden, or priviate place where you may clearly see the Stars both above and below the Pole, here pitch exactly upright, and at some distance two poles of a good length, let this be done just at Noon of the

the day, ſo that the ſhaddow made (by the Sun at that time) of them both may be in a direct line, and this is a true Meridian. This being premiſed.

(4) If at any time of the night you would find the hour by the *Nocturnal*, ſtand by the Southermoſt of your Poles, (before ſet up) bring it in a right line with the other, ſo that the Pole by you may hide the other from your eye: then ſee what Stars are hid from your eye by theſe two Poles, either a bove or below the *Polar* or North *Star*, Theſe are then upon the Meridian; Then coming to your *Nocturnal* by the help of your Thred bring the movable part thereof into the ſame poſition as you find the Stars in the Firmamt, ſetting thoſe upon the Meridian under the Thred, that you find to be hid from your eye, by the two Poles: then find in the movable part the day of the Month of your Obſervation, and juſt againſt it on the fixed part you ſhall find the hour of the Night.

5. But

(5) But as it would be a most certain way to have a Meridian for a while to excercise until you are well acquainted with the operation and performance, yet may you come very near to the matter (and near enough for common Use) without a Meridian thus, *viz.* when you know the Polar Star, place your body Directly upon the Star and imagining a Line drawn from the Zonith or point directly over your head through the said *Star*, and so directly down to the Earth, observe what Stars of those that are on your Plate, either over or under the Pole Star, are upon that supposed line which is your Meridian, then coming to your Nocturnal place the Movable part in the same Posture, and just against the day of the Month on the movable part is the hour of the night.

6. An example or two, will make all plain.

Suppose upon the first of *August*, in

in the year 1684. finding by either of the former ways, that the two Stars of *Charles*'s *wayne*, that are fartheſt from the Tayle of the Bear (which as I ſaid before point directly to the Polar Star) are on the Meridian below the Pole, then coming to my *Nocturnal* I bring thoſe Stars under my Thred below the Pole, and then looking for the day of the Month *Auguſt* 1ſt. I find that 'tis almoſt half an hour paſt one a clock in the Morning. And the ſame Night finding that Star in the Noſe of the great Bear, to be on the *Meridian* below the Pole, I place this under my ſtring in my *Nocturnal*, and ſeek the Day of the Month, and againſt it I find it to be half an hour paſt 10 at Night, and ſo upon *July* the *1ſt.* finding the Star *Hircus* (a Star of the firſt Magnitude) to be on the Meridian below the Pole, I bring my movable part to 'its proper place (as before directed) and find it to be half an hour paſt nine a clock at night, *et ſic de ceteris.* *Uſus promptos facit*

AN APPENDIX.

SECT. I.

The Discription of the Universal Ring-Dial, which sheweth the Hour of the Day in any Part of the World, and the Latitude also.

(1) THis Instrument is generally known, and very useful for most Persons,& a Pocket Companior. It is projectedout of two *Great Circles* of the *Sphear*. Also an *Axis* and a little Ring to hang it by, and the making thereof well known to the Workman. (2) The greater Circle is the *Grand Meridian*, one *Quadrant* or

or *Quarter* thereof is divided into Ninety Degrees, to set it to the Latitude of the Place whereever you are. On the other side of the *Meridian* is a Quadrant of *Altitude*, to take the height of the *Sun*, thereby to find the Latitude of the place.

The lesser of these two Circles, (though both represent great Circles of the *Sphear*) is the *Æquinoctial*, divided into 24 equal Parts or Hours, with their Halfs and Quarters, which are numbred but from Three in the Morning, to Nine at Night; the rest of the Hours are left out being seldom or never used.

(3) The Diameter or Broad-Plate hath a slit in the middle, and upon one side are the Months and days of the year, Graduated to every fifth day. On the other side is the *Sun's* declination from the *Æquinoctial* to every fifth day, which is to be used with the *Quadrant* of *Altitude*, to find the Latitude

titude of the place; The little Ring is made to ſlide along the *Quadrant.* with a ſmall Tooth to ſet it to the Latitude, and the uſe of this Portable and General Inſtrument is as Followeth.

SECT.

SECT. II.

The use of the Ring-Diall *in several Examples, first to find the Latitude, and Secondly the Hour of the day in any place throughout the habitable world, and therefore an Excellent Companion for all Travellers, Gentleman, or others of what degree, or Quality soever, 'tis fit they should accommodate themselves with both this and the Quadrant, the one* being General, the other particular, and the one supplys the defects of the other.

(1) *For the Elevation of the Pole or Latitude of the Place.*

FIrst set the hole in the moving piece (or Bridge so called by some) to the day of the Month, then turn the other side and right against the

the hole is the *Suns Declination* for that day, The ſame day take the *Sun's Meridian Altitude* (which is his hight at Noon every day) and may be performed by this Inſtrument thus: Put a pin into the hole, which you ſhall find in the greateſt Circle, then move the *Tooth* to the begining of the degrees in the Leſſer *Quadrant*, and turn the pin next to the *Sun*, and that degree which is cut by the *ſhaddow* of the *pin* is the *Sun's Altitude*, (which muſt be taken juſt at Noon as aforeſaid)

2 If the time of your Obſervation be from the 10*th*. of *March* to the 13*th*. of *September* you muſt ſubſtract the Declination out of the *Meridian Altitude* of the *Sun*, but from the 13*th*. of *September*, to the 10*th*. of *March*, adde, and the ſum, or difference ſhall be the Complement of the Latitude or Æquinoctial hight, which being ſubducted out of 90 degrees, leaves the Latitude of the Place. *Ex-*

Example. I.

(1) Suppose the Latitude was unknown, and upon the 11*th.* day of *June* you desire to find it, then by the former Rule find the Suns Declination for that day, which will be 23 *deg.* and 30 *min.* (or the *Suns* greatest Northen *Declination*, then take the *Suns* Altitude just at 12 of the clock, which at and near *London*, will be found 62 *degrees* then Substract the *Suns* Declination 23. 30 out of 62 *deg.* and the remainder will be 38 *gr.* 30 *min.* the complement of the Latitude or *Æquinoctial* hight, which Subducted from 90 degrees leaves 51. 30 *min.* for the Latitude of *London.*

Example. II.

(2.) As the former Directions shews how to Observe he Latitude the *Longest*

longeſt day in the year, when the *Sun* has his greateſt *Northern Decliation*, ſo here admit that on the 10 of *December*, when the *Suns* greateſt *Southern Declination* is alſo 23 30 min. But the *Meridian Altitude* but 15 degrees: Adde theſe two Numbers together and they make 38 30 min which deducted from 90 deg. leaves the Latitude as before. 2. *To find the Hour of the day.* You muſt ſet the Tooth to the height of the Pole or Latitude of the Place, and ſlide the hole in the Plate to the day of the Month, then draw out the Æquinoctial or leſſer Circle, and as near as you can gueſs at the Hour and turn the hole to it, then hold the Inſtrument by the little Ring, and move it till the *Sun* ſhine through the hole upon the middle line in the *Æquinoctial*, and that is the true hour of the day deſired, and the *Meridian* as it hangeth lyes in the *Meridian* of the world truly North and South.

An

AN APPENDIX.

The Use of Gunters Line in Measuring Board and Timber.

1. *ADmit a Board be* 10 *Inches Broad* 20 *and foot long I demand the Contents.*

Set one foot of the Compasses in 12 and extend the other to 10, then set one foot in 20, and extend the other Backwards and it will fall in 16 foot and a half which is the content of the Board required.

2. *Admitt*

2. *Admitt a Board be* 15 *Inches broad and* 27 *foot long I demand the Content.*

Set one foot in 12 and Extend the other to 15, then set one foot in 27 and extend the other forward, and it will fall in 34 foot which is the content requir'd

3. *Admit a Board, to be* 7 *Inches and a half Broad, and* 29 *foot Long, I demand the Content.*

Set one foot in 12 and extend the other to 7 ½, then set one foot in 29, and extend the other Backwards and it will be in 18 foot the content required.

4. *Admitt a Board to be* 27 *Inches Broad and* 9 *foot and a half long, I demand the content.*

Set one foot in 12, and extend the other to 27, then set one foot in 9 ½, and extend the other forwards and it will fall in 21 and a Quarter which is the content desired.

5. *Admit*

5. *Admit a piece of Timber to be 8 Inches ſquare and 20 foot long, I deſire to know how many ſquare feet there is contained in this peice of Timber.*

Set one foot in 12, and extend the other to 8, then ſet one foot in 20 and extend that diſtance twice backward and it will fall in 8 foot 3 quarters, which is the true content required.

6. *Admit a piece of Timber to be 9 Inches and ½ ſquare, and 27 foot long, I demand the content.*

Set one foot in 12 and extend the other to 9 ½ then ſet one foot in 27, and extend that diſtance twice backward, and it be will in 17 foot, the true content Required.

7. *Admit a piece of Timber to be 18 Inches ſquare and 9 foot long I demand the content.*

Set on foot of the Compaſſes in 12, and extend the other to 18, then ſet one foot in 9 and extend that diſtance, twice forward and it will fall in 20 foot

foot and ½ the content desired.

8. *Admitt a piece of Timber to be 22 Inches square and 35 foot long; I demand the content.*

Set one foot in 12 and extend the other to 22, then set one foot in 35, and extend that distance of the Compass twice forward, and it will fall in 118 foot which is the content required.

9. *Admit I have the Breadth of a Board in Inches, to find how much in Length will make a Foot superficial.*

Extend the Compasses from the Breadth to 12, the same will reach from 12 to the content forward, if the Breadth be less then 12, and Backward if the contrary.

FINIS.